Thyridopteryx has its halves united by a double commissure, one portion crossing above and the other below the œsophagus. When the nervous system has been separated from the superficial ectoderm, a median ingrowth of ectoderm occurs in *Thyridopteryx* between the nerve-cords. The cells composing this ingrowth elongate and lie close to the nerve-cords.

At this stage it appears as if this median ingrowth were uniting the cords and forming a commissure, as Hatschek claimed for the Lepidoptera studied by him. This, however, does not prove to be the case. In a subsequent stage the elongated epithelial cells undergo division and give rise to migratory cells corresponding to other migratory mesoderm cells. Cells of this nature invest the nervous system, forming its peritoneal coat, but take no part in the formation of its commissure. The three pairs of thoracic limbs are conspicuous from their size in all embryos studied.

In the grasshopper both maxillæ have two lobes outside of and at the base of the main axis of the appendage. These recall, though they are probably not homologous with, the exopodites and epipodites of the Crustacean appendage. Similar lobes have been described by Patten for the maxillæ of *Blatta*. Tracheal invaginations occur in the maxillary segments of the grasshopper. In conclusion, it remains to mention an interesting stage of the spider-embryo in which an abdominal appendage is being converted by a process of invagination into a lung-book.—*Johns Hopkins University Circulars*, no. 49, May 1886, p. 85.

Notes on the Embryology of the Gasteropods.

By J. Playfair McMurrich.

In a number of the 'Studies from the Biological Laboratory,' which will appear during the coming summer, I intend publishing a detailed and illustrated account of the results of my studies during the past winter upon the development of some marine Prosobranch Gasteropods. In the meantime, however, it is desirable that a brief abstract of some of the more important results should be presented.

The forms studied principally were *Fulgur carica* and *Fasciolaria tulipa*. The former furnished material for the earlier stages of development, while of the latter I studied only the more advanced embryos. The modes of segmentation of a few other forms, such as *Purpura floridana*, *Crepidula*, and *Eupleura caudata*, were also observed.

The first portion of my paper will deal with the ovum and the nutrition of the embryo, the non-development and employment as nutrition of the majority of the ova in each capsule of *Fasciolaria* being described and compared with other phenomena of a similar kind. In *Purpura floridana* a certain number of the ova, after segmenting regularly for some time, break down, and are employed as food by the survivors; in *Crepidula* we see the same process, but in a much less marked degree; while in *Neritina* it is carried to a greater extent, only one egg, out of a great number which, in each

capsule, undergo segmentation, coming to maturity. In *Fasciolaria* six or eight eggs develop in each capsule, the remaining ova showing not the slightest traces of segmentation, the polar globules even remaining unformed, although the ova contain a nucleus and a certain amount of protoplasm and are not simply yolk-masses.

The second portion of the forthcoming paper will deal with the segmentation of *Fulgur*. The eggs are very large, containing much yolk. A single large polar globule is formed which contains some yolk-granules. The ovum then segments into two and then four equal spherules, and from these are separated four small protoplasmic spherules, the micromeres. These then divide, after four more micromeres have been separated from the macromeres, as in the normal Gasteropod segmentation. In one point, however, *Fulgur* differs from other forms which have been studied; the number of generations of micromeres which are separated off from the macromeres is very large—apparently they continue to be separated off as long as any portion of the macromeres remains uncovered by the ectoderm. And even after the blastopore has formed and closed at the nutritive pole of the egg there can be seen, in the interior of the yolk-mass, which represents the fused macromeres, or beneath the ectoderm at the surface of the yolk-mass, cells which resemble, in certain characteristic features, the micromeres which were separated from the macromeres. These late-appearing micromeres, as they may be termed, I believe, assist in the formation of the mesoderm, this layer not being formed in its entirety from the primitive mesoderm-cell.

When the segmentation has progressed somewhat, but while the micromeres are still confined to the formative pole, three of the macromeres show elongated elevations upon their surfaces. The fourth macromere has no elevation, but gives rise to the primitive mesoderm cell. What the significance of the elevations may be I cannot imagine, but there can be no doubt that their appearance is normal, and coincides with the formation of the first mesoderm-cell; this lies below the margin of the ectoderm-cell, and corresponds exactly with the primitive mesoderm-cell of *Nassa*.

At a later stage an invagination of the ectoderm at the formative pole takes place. A deep depression is formed, which, however, later disappears and leaves no trace. It apparently corresponds with the similar invagination described by Blochmann in *Neritina* and by Sarasin in *Bithynia*, though the description given in this latter case is not very clear.

The development of the endoderm I was not successful in observing. The blastopore is formed at the formative pole of the ovum, and closes, the mouth being formed at the point of closure by an ectodermal invagination which also gives rise to the œsophagus.

The general considerations derived from the study of the segmentation of the Gasteropods will be arranged under three divisions. The first will treat of the influence of the yolk on the formation of polar globules, the second on the phylogenetic significance of segmentation, in which it will be held that the mode of segmentation

seen in *Fulgur* and so many other Gasteropods is essentially the same as that which occurs in certain Hirudinea, Gephyreans, Turbellarians, &c., and that which is to be seen in the Lamellibranchs, Annelida, and other aberrant groups can be referred to the same mode; or, in other words, that the Platyhelminths, Annelida, Mollusca, and Molluscoidea have been derived from forms which possessed a typical segmentation similar to that now to be seen in the Pulmonates and many other Gasteropods, many forms in each group, however, having departed from the original mode by reason of subsequent loss or addition of food-yolk. It will follow, as a consequence of this idea, that the regular equal segmentation, which occurs in many forms belonging to these groups, is not primitive, but has been secondarily induced by the conditions under which the eggs segment. The third division of the theoretical considerations will treat of the mesoderm.

The third and fourth portions of the paper will treat respectively of the velum and primitive excretory organs.

The fifth portion will treat of the development of the nervous system. It will be shown that the Lamellibranchs, Pteropods, and Heteropods agree in the formation of their supraœsophageal ganglion with the typical Trochophore larva of *Polygordius*. In the marine Prosobranchs, however, the supraœsophageal ganglia arise as independent local ectodermal thickenings, which have directly nothing to do with a "Scheitelplatte," and which become united with each other and with the pedal ganglia later. Between this arrangement and that of Pteropods &c. the Pulmonates offer an intermediate stage. The problematic cells which have been described by so many authors as lying in the head vesicle, and as derived from the ectoderm, and which were recognized by Wolfson to be a nervous organ in process of degeneration, no doubt represent the apical thickening from which, in the Trochozoon, the Pteropods, &c., the supraœsophageal ganglia are formed. In the Pulmonates the ganglia do not form from these problematic cells, which soon degenerate and disappear, but are formed, as in the marine Prosobranchs, from local proliferations of the ectoderm. There has been an abbreviation of the development in the case of the Pulmonates and Prosobranchs, and it is interesting to note that the latter group presents wide differences from the other Molluscan larvæ in other respects also, *e. g.* the excretory organs. The Prosobranch Veliger seems to be very highly specialized, and affords an excellent instance of larval specialization independent of the specialization of the adult.—*Johns Hopkins University Circulars*, no. 49, May 1886, p. 85.

On the Development and Minute Structure of the Pedunculated Eyes of Branchipus. By Dr. Carl Claus.

The lateral eyes of *Branchipus* possess an increased interest because, like those of the Decapoda and Stomatopoda, they are placed upon movable stalks which have only been developed in the